V2X standardization and deployment: viewpoint of a system provider

Les Journées Nationales des Communications dans les Transports, JNCT 2013

29th May 2013

Lan LIN

lan.lin@hitachi-eu.com

Information and Communication Technologies Laboratory (ICTL), FRANCE

HITACHI
Inspire the Next

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Outlines

- Background
- V2X deployment
- Standardization and main technical features
- ICTL activities on V2X and beyond.

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Background

HITACHI
Inspire the Next

- Intelligent Transport System (ITS) targets at:
  - Road safety
  - Traffic efficiency
  - Environmental effects
  - Comfort and mobility
- Modern society and industries are living some transformations:
  - Connected lifestyle, even in the car
  - Social networks
  - Multimodal mobility
  - Smart cities

→ Cars will interact with their environment in many different ways

→ New stakeholders in the value chain

→ Approaching of consumer industries and automobile industries

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Fact sheet: Road safety

The Commission's Road Safety Programme aiming at cutting road deaths in Europe between 2011 and 2020.

- Road Safety is a major societal issue. In 2011, more than 30,000 people died on the roads of the European Union.
- For every death on Europe's roads there are an estimated 4 permanently disabling injuries.

Source: European Commission

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Fact sheet: Vehicle connectivity

HITACHI
Inspire the Next

Telematics:

- Telematics shipment is foreseen to reach 30 millions at 2017 in western Europe
  - Aftermarket devices and OEM embedded/hybrid devices are having equivalent share.
  - The penetration rate is estimated to reach more than 90% at the same time scale.

Vehicle safety system:

- ADAS Overall Value World Market is increasing rapidly and the trend seems continue
- Connectivity based safety systems will be deployed in EU and in world wide:
  - eCall directive in EU.
  - ITS G5 technologies in EU/DSRC in USA/ITS spot services in Japan

Vehicle and infrastructure integration:

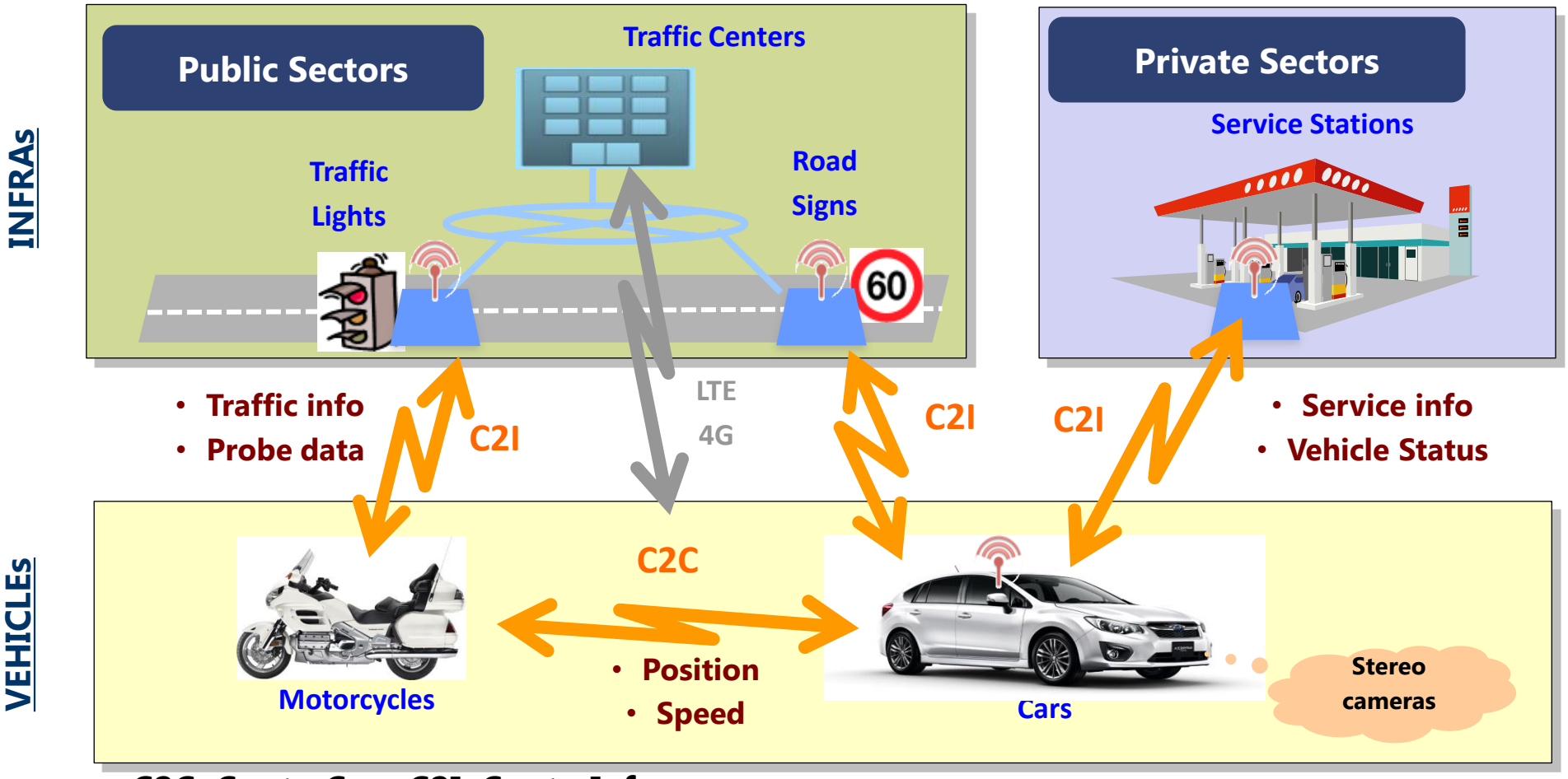
- Infrastructure service provision based on I2V (Infrastructure to Vehicle) to further stimulate the penetration rate.
- ITS in smart cities, smart energy management.

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

What is C2X ?

Cooperative System by Car-to-Car and Car-to-Infrastructure Communications for Traffic Safety and Efficiency, and for Automotive Infotainment:

- Various communication media and protocols
- Multiple applications/services
- Open platform



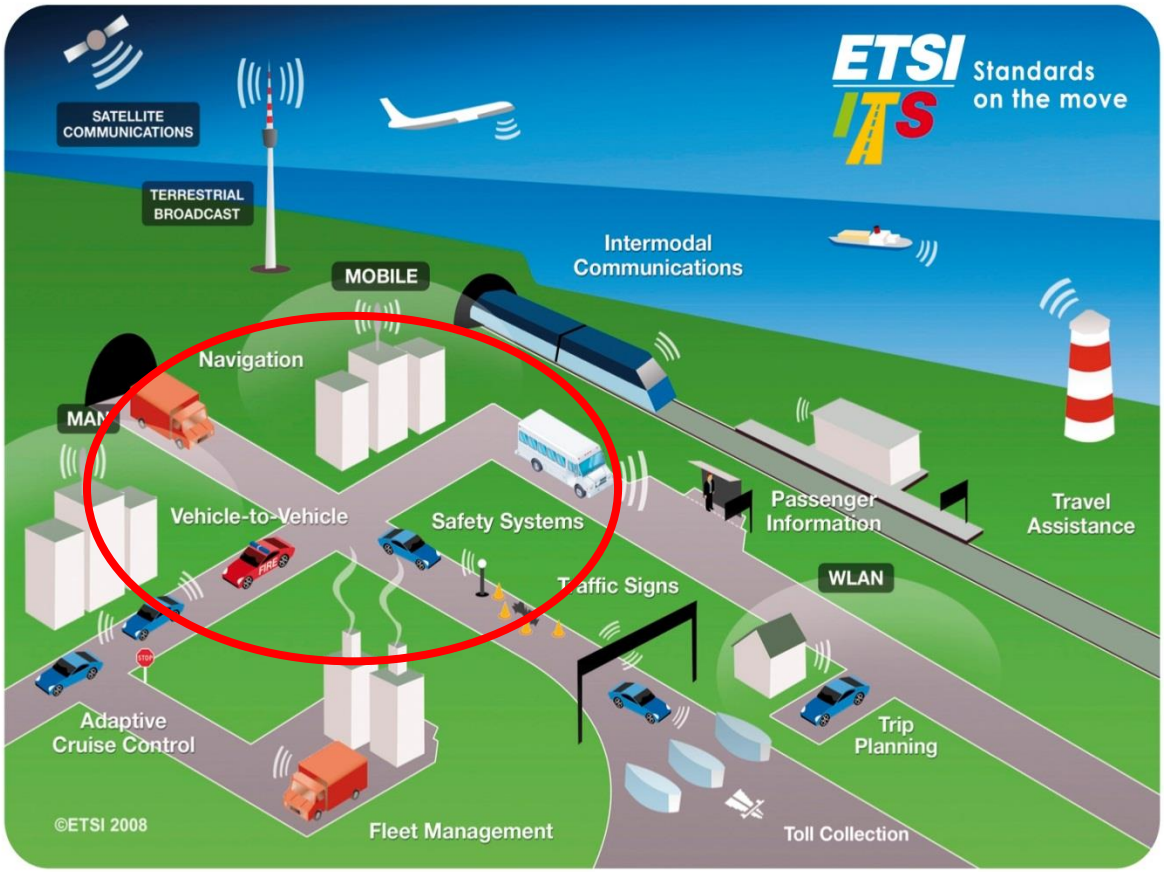
C2C: Car to Car C2I: Car to Infra

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Cooperative ITS (V2X) systems

HITACHI
Inspire the Next

5,875 – 5,905 (ITSG5A/ITSG5B) spectrum has been allocated in EU for road safety and traffic efficiency application. However, C-ITS may use other technologies such as cellular, WLAN.



ITS G5 technologies:

- Quick media access → low latency communication
- Ad hoc communication → no infrastructure requirements
- Allocated spectrum for ITS → communication reliability
- 200-800m communication range → extended view for vehicle compared to RADAR, LIDAR

ITS G5 is considered as main candidate for road safety applications by European C2C-CC

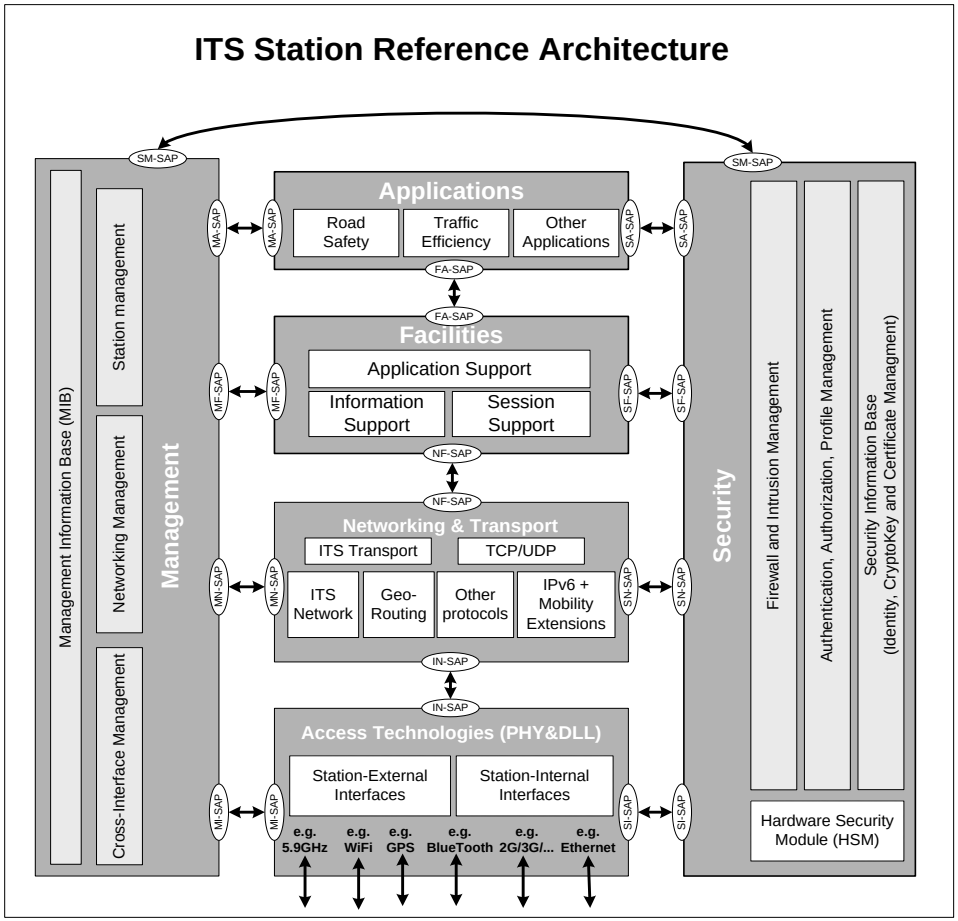
V2V V2I deployment will stimulate the deployment and penetration rate.

Source: ETSI

C2C-CC: car to car communication consortium

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

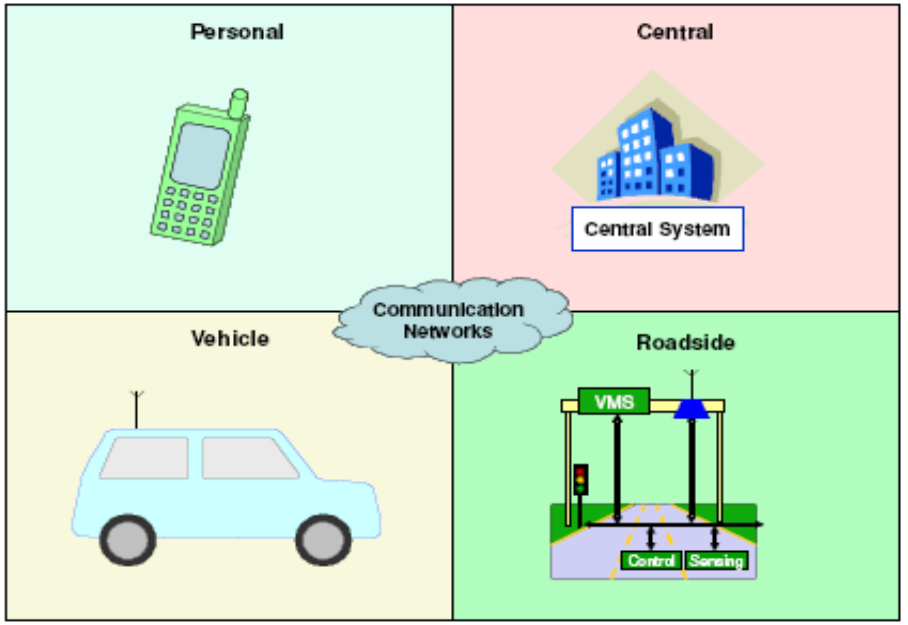
ITS station communication architecture



- ITS vehicle station
- ITS road side station
- ITS central station
- ITS personal station

ETSI TC ITS modular architecture, supporting

- Multiple applications
- Multiple communication protocol
- Multiple access technologies



Source: ETSI

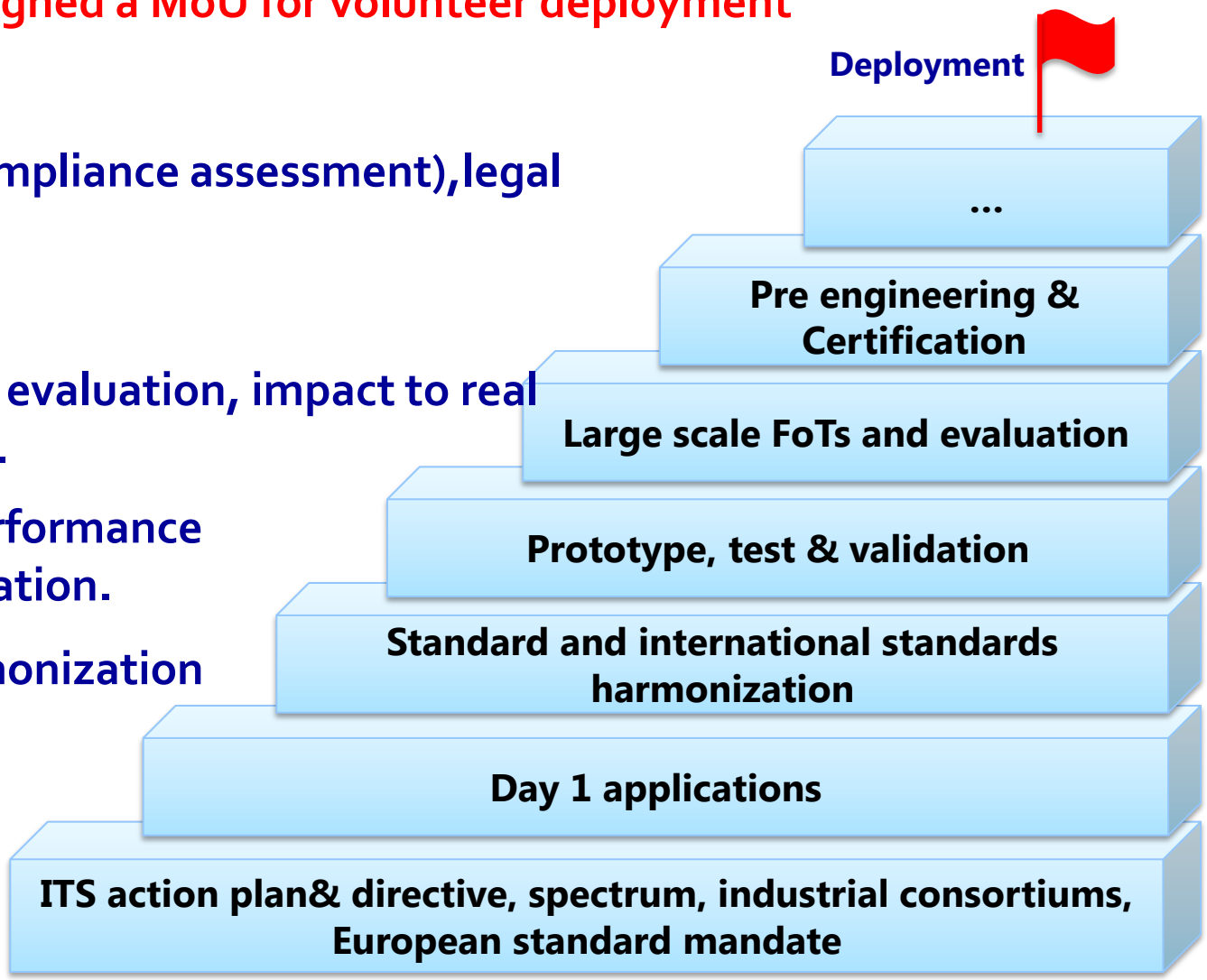
All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Pave the road for deployment

HITACHI
Inspire the Next

Car makers in C2C-CC have signed a MoU for volunteer deployment from 2015 on.

- Security, certification (compliance assessment),legal framework.
- Application effectiveness evaluation, impact to real traffic , user acceptance…
- Standard compliance, performance validation, system integration.
- Interoperability and harmonization
- Minimum requirements.
- Strategic support.

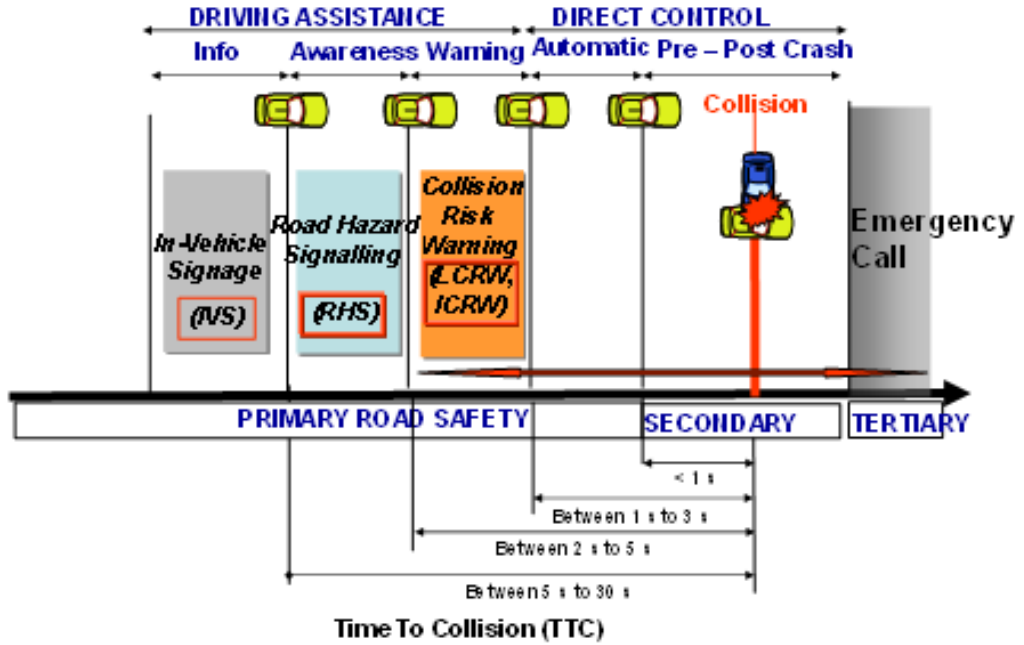

Deployment
…
Pre engineering & Certification
Large scale FoTs and evaluation
Prototype, test & validation
Standard and international standards harmonization
Day 1 applications
ITS action plan& directive, spectrum, industrial consortiums, European standard mandate

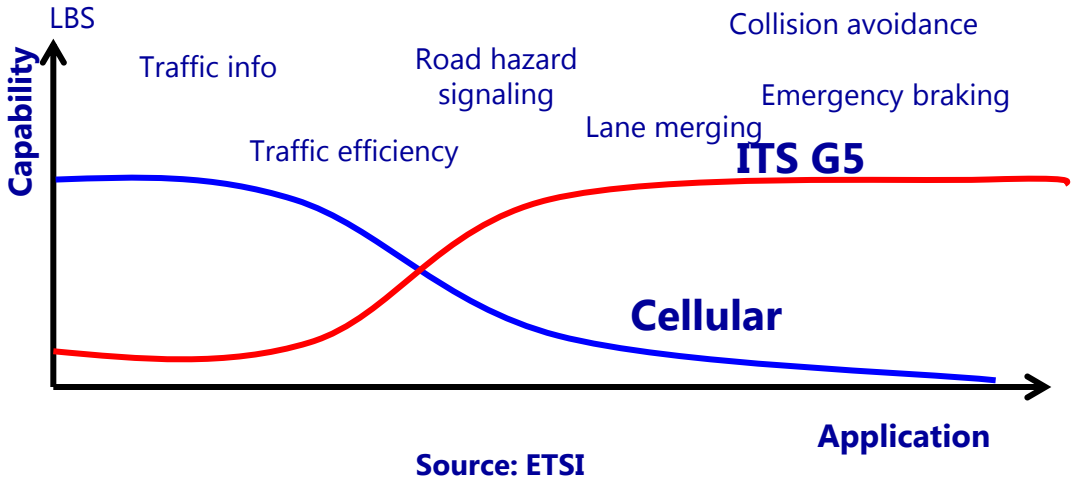
FOT: Field Operational Test

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

V2X applications

- V2X extends the view of radar based proactive or active safety.
- Technology agnostic
- But application requirements may result in specific choice of technologies:
  - Reliability
  - Communication coverage
  - Latency
  - Interoperability



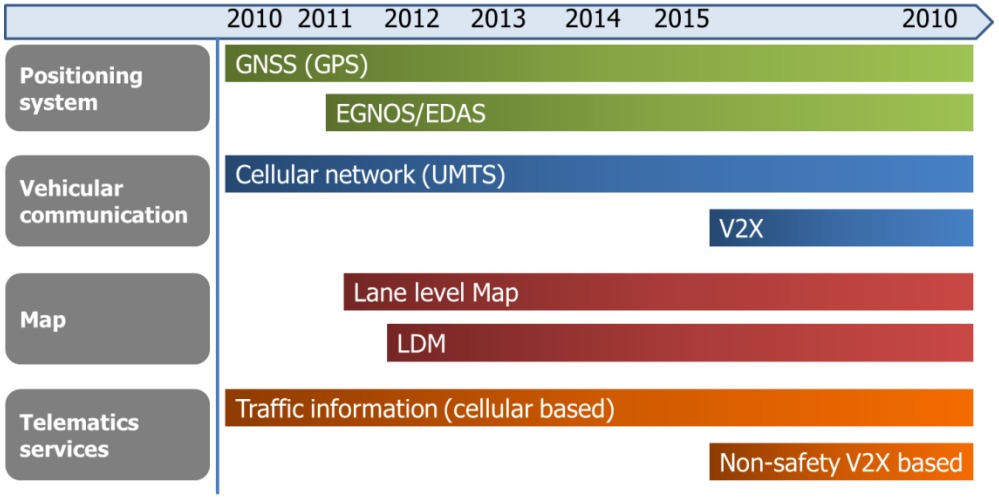


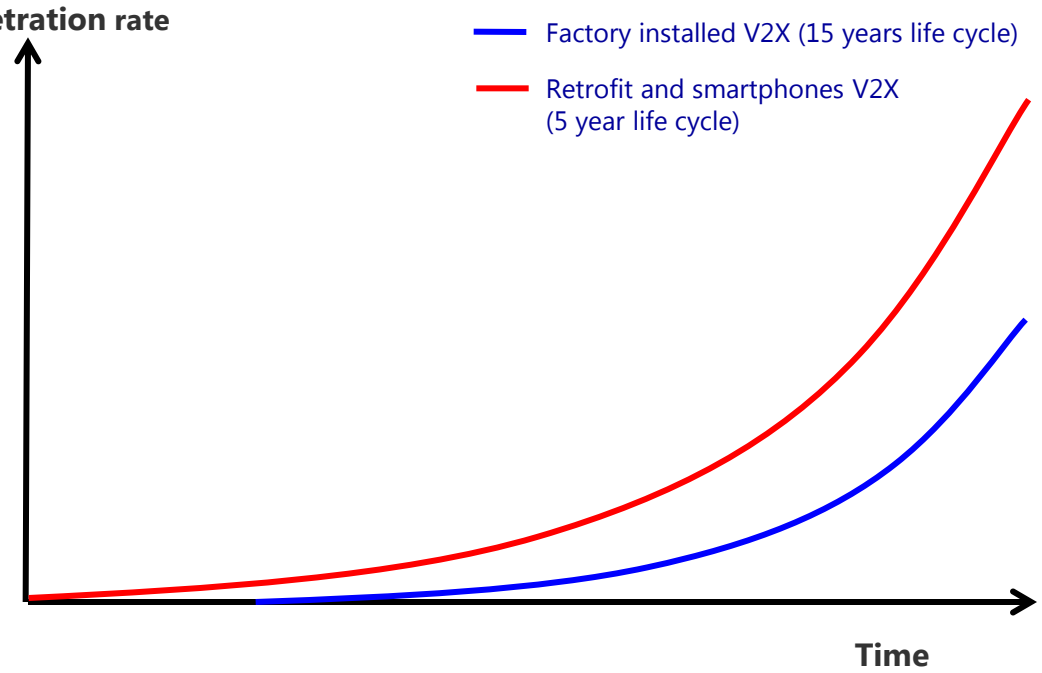
Source: ETSI

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Deployment and penetration rate

- V2V based applications required a minimum penetration rate.
  - C2C-CC estimates that 10% is required for V2V safety
  - Critical for reaching critical mass in installed base
    - Only 14 million vehicles sold / 250 million installed base
- Retrofit solution and/or smartphone based system may stimulate further the penetration rate
- Other factors:
  - Infrastructure based applications
  - Infotainment applications





All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Standardization: essential part of ITS

Standardizations (or amendment of current standards) is essential, with the regulation on spectrum usage.

- Communication interoperability
  - Communication protocol stack.
    - Access (PHY MAC)
    - Networking & transport
  - Standardized message exchanges
    - Message format, high layer protocol
- Modularity:
  - To enable multiple implementation strategy.
  - Layer base architecture and protocol design.
- Performance:
  - Basic performance requirements:
    - Data quality, information availability, congesti
- Compliance and testing
  - Standardized test specifications are required.
- Certification and testing :
  - Standard compliance testing
  - Interoperability testing
  - System performance compliance assessment

Source: DRIVE C2X

PLUGTESTS™ INTEROP EVENTS

ERTICO ITS EUROPE

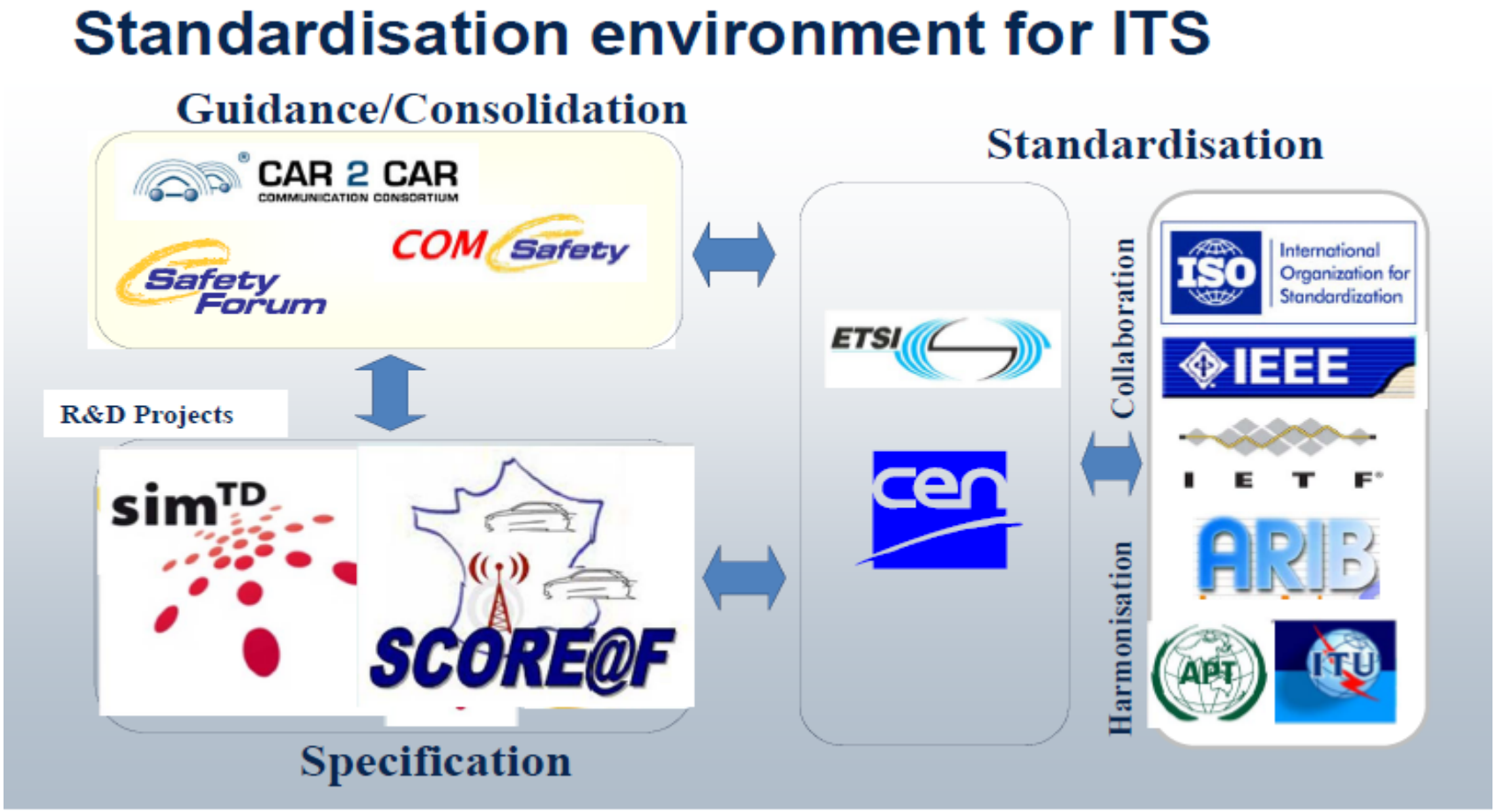
CAR 2 CAR COMMUNICATION CONSORTIUM

cen

ETSI

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

HITACHI
Inspire the Next



23 Nov 2010

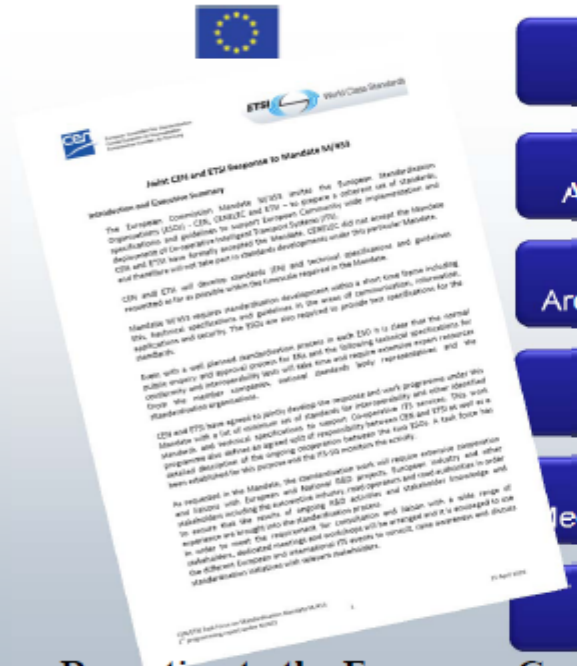
CAR 2 CAR Forum 2010

CAR 2 CAR
COMMUNICATION CONSORTIUM

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

ETSI TC ITS: M/453

ETSI Standardisation activities – M/453



ETSI TC ITS

- WG1 Application requirements ⟺ WG APP
- WG2 Architecture and cross layer ⟺ WG ARC
- WG3 Network and transport ⟺ WG COM
- WG4 Media and media dependent
- WG5 Security ⟺ WG SEC

C2C TC

Reporting to the European Commission

Jan 2010 → Apr 2010 → Jan 2011 → Sep 2011 → Jul 2012

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Main technical features and standards

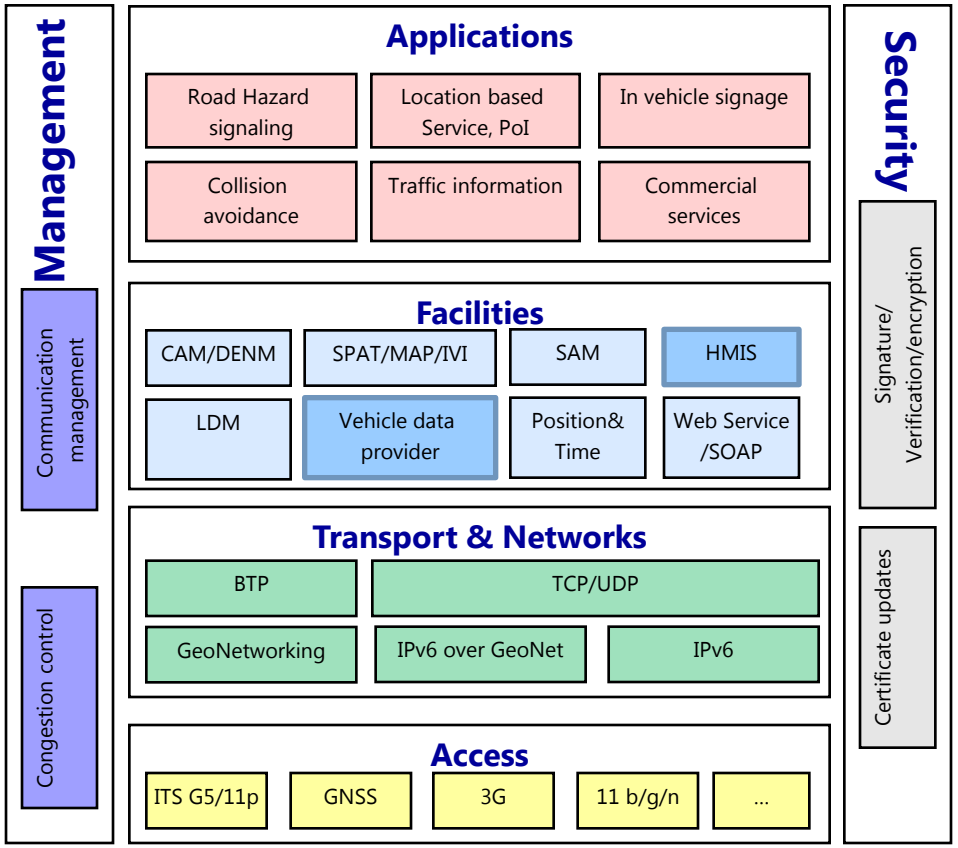
HITACHI
Inspire the Next

- Periodical broadcasting vehicle position and basic sensor information up to 10Hz.
- Traffic event message
- Traffic light phase and timing information
- Road topology information
- Road signage information
- Service announcement
- Local dynamic maps database
- Position and time information
- HMI supports
- Vehicle CAN bus gateway
- Other high layer protocol (web service, SOAP, HTTP)

- Geo position based addressing and routing
- Legacy IP stack
- Transmission of IP over GeoNet

- Dynamic selection of communication profile
- Network and media congestion control

- Certificates update with PKI
- Communication security mechanism
- IP security



Source: ETSI

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

ICTL – Information and Communication Technologies Laboratory

8 people,
7 researchers

Sophia Antipolis – FRANCE

ICTL located side of ETSI, the EU Telecomm. Standard. Institute.

Samsung and Intel recently opened R&D sites on Sophia as well

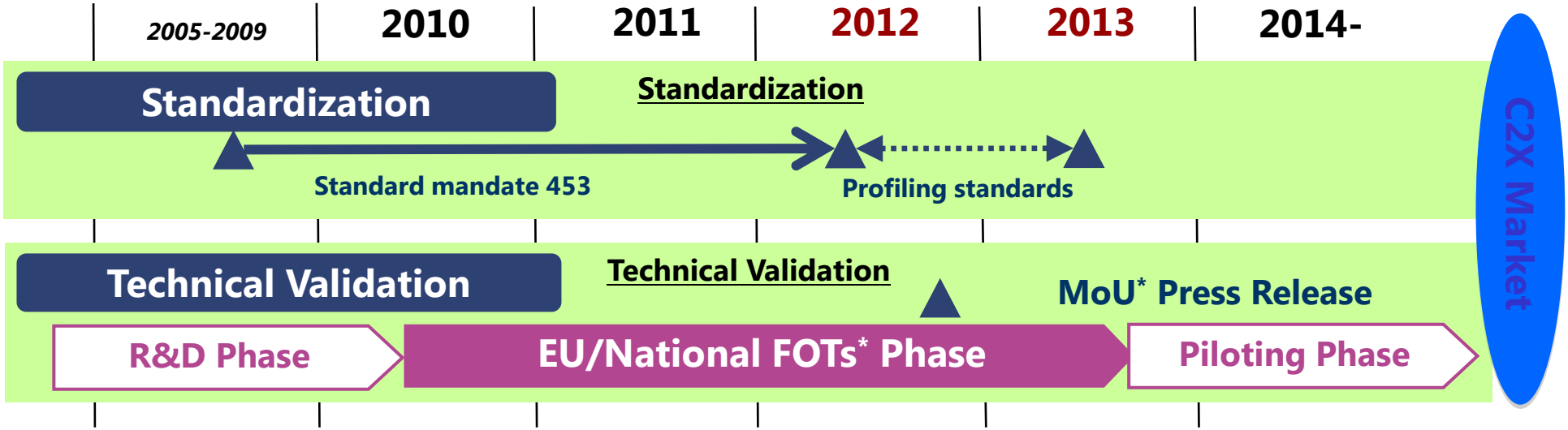
ICTL

Phase	Exploration – Maturation	Research/Development – Business Support	
Period	1997– 2004	2004 – 2011	2011–
Topics	Wireless Communications, Ad Hoc Networks	Vehicular Comms (C2X*)	ITS** & Smart Mobility (e.g. eCo-FEV Pj)

***C2X: Car to Any **ITS: Intelligent Transport Systems**

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

C2X activities in EU



ICTL plays important roles in the C2X community

ICTL in Standardization

ETSI ITS Tech Committee

- WG1 (Application): Co-chair
- WG2 (Architecture)
- WG3 (Networking): Editor
- WG4 (Media)
- WG5 (Security)

ICTL in EU/National FOT* Projects

Steering Committee Member

- SP1 (Pj Mngmt)
- SP2 (Specs): Leader
- SP3 (FOT)
- SP4 (Evaluation)
- SP5 (Promotion)

FOT prototype

*FOT: Field Operational Test *ITS: Intelligent Transport Systems
*MoU: Memorandum of Understanding

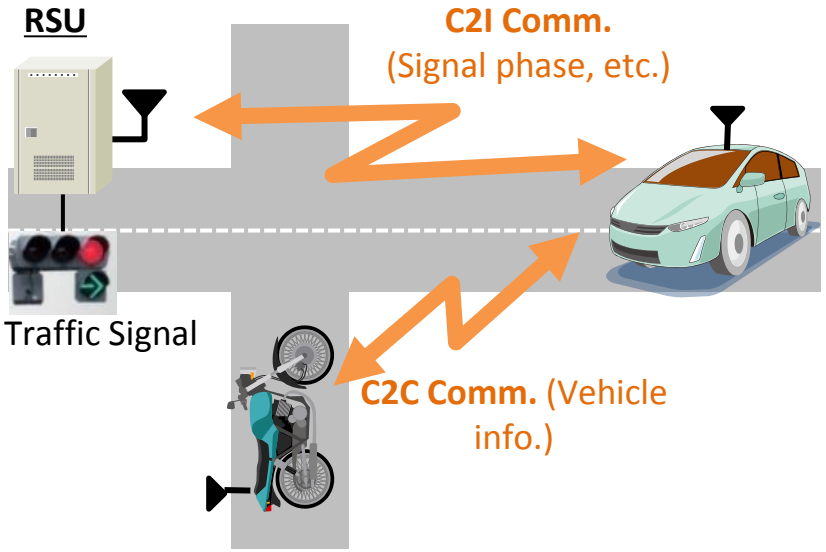
ICTL roles

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

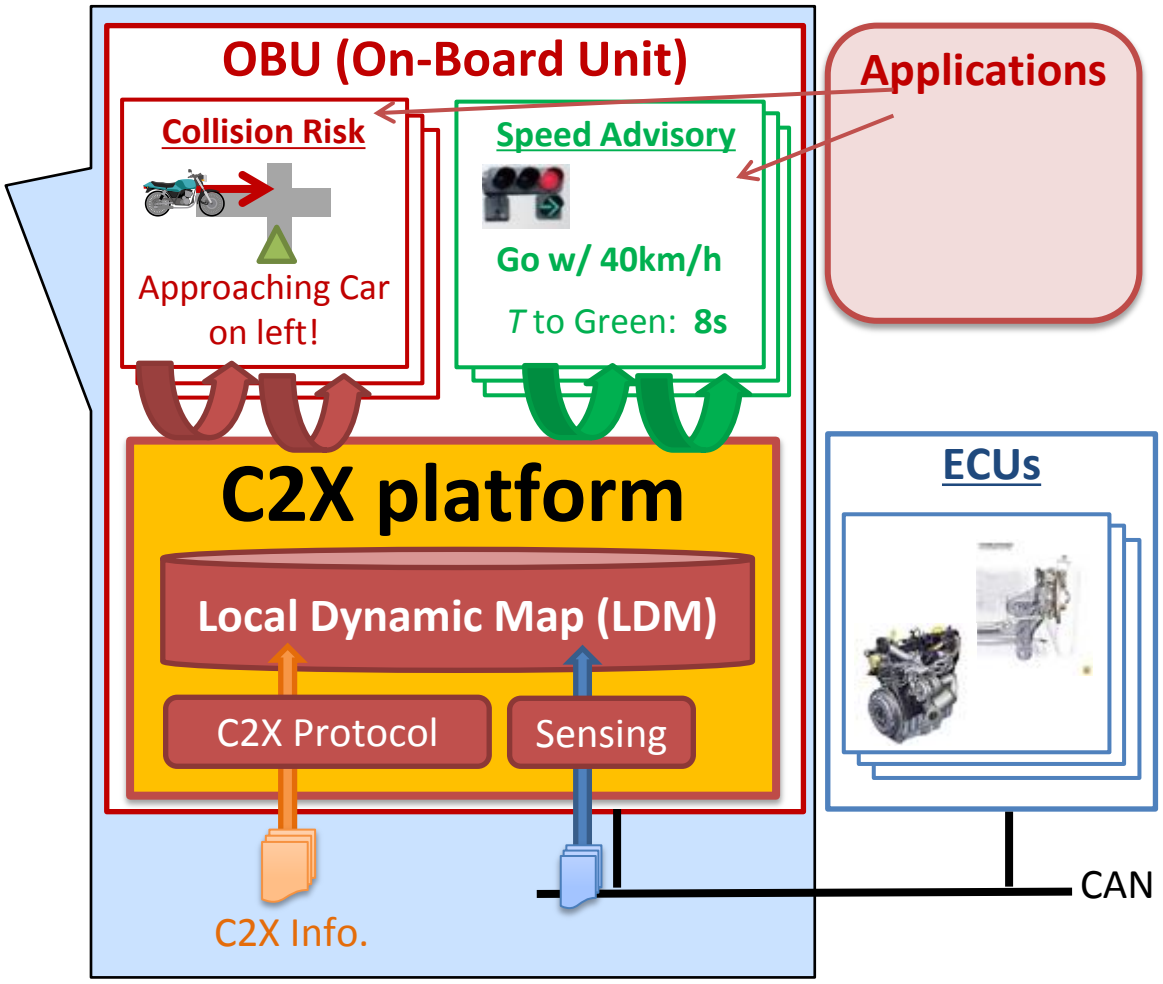
C2X Comm. Platform developed by ICTL in FOTs

HITACHI
Inspire the Next

General scenario



C2X platform technologies to analyze surrounding info. in real-time



All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

C2X Technologies by ICTL

HITACHI
Inspire the Next

ICTL Develops advanced functions of C2X geoNetworking protocol

C2X Protocol Stack

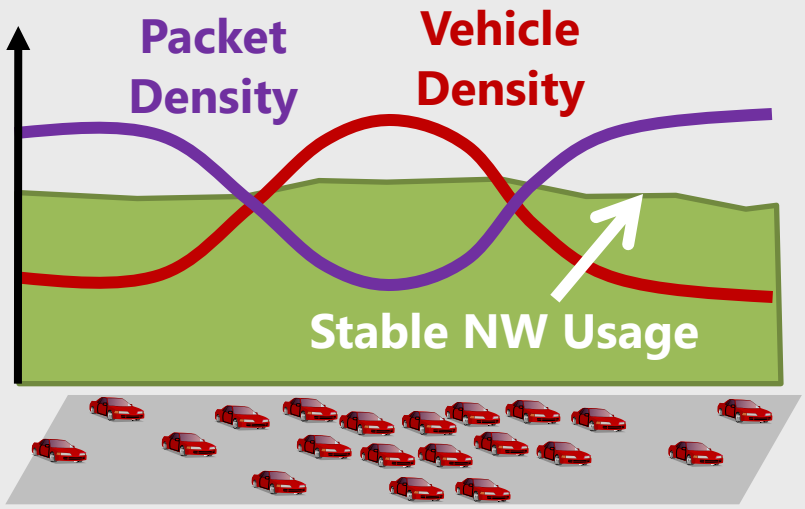
- Applications
- Facility
- Network
  - GBC
  - TIC
- PHY/MAC*

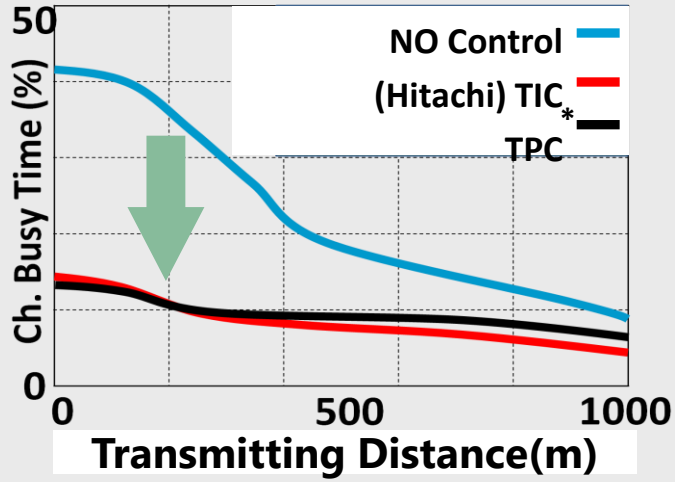
Advanced Forwarding Protocols

Area-based Multihop Broadcast

Transmission Interval Control (TIC)

Spatially-stabilize NW usage





PHY: Physical Layer MAC: Media Access Control TPC: Transmission Power Control GBC: Geo-broadcast

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

DRIVE C2X project overview: test sites

HITACHI
Inspire the Next

Seven test sites:

System test site:

- Helmond/Eindhoven, The Netherlands

Functional test sites:

- Tampere, Finland,
- Yvelines, France,
- Frankfurt, Germany,
- Brennero, Italy,
- Gothenburg, Sweden
- Vigo, Spain

Supported by

CAR 2 CAR COMMUNICATION CONSORTIUM

EUCAR
EUROPEAN COUNCIL FOR AUTOMOTIVE R&D

Collaboration partner

EasyWay

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

DRIVE C2X project overview: Use cases

HITACHI
Inspire the Next

Safety	Traffic Efficiency	Infotainment and Business
Traffic jam ahead warning (BSA: Traffic condition warning)	In vehicle signage/ Speed limit	Insurance and financial services *
Roadworks warning	Green light optimized speed advise (BSA: Traffic light optimal speed advisory)	Dealer management*
Car breakdown warning		Point of interest notification
Approaching emergency vehicle (BSA: Emerg. vehicle warning)		Fleet management*
Weather warning		Transparent leasing*
Emergency electronic brake lights		
Slow vehicle warning (BSA: slow vehicle indication)		
Post-crash warning (BSA: Stationary vehicle-accident)		
Obstacle warning		
Wrong way driving in gas stations		
Motorcycle warning (BSA: Motorcycle approaching indication)		

- Use cases in green are listed in ETSI BSA.
- Safety applications are under standardization

* currently pending

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

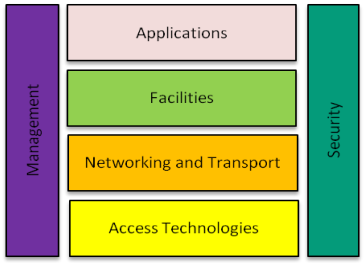
DRIVE C2X Architecture

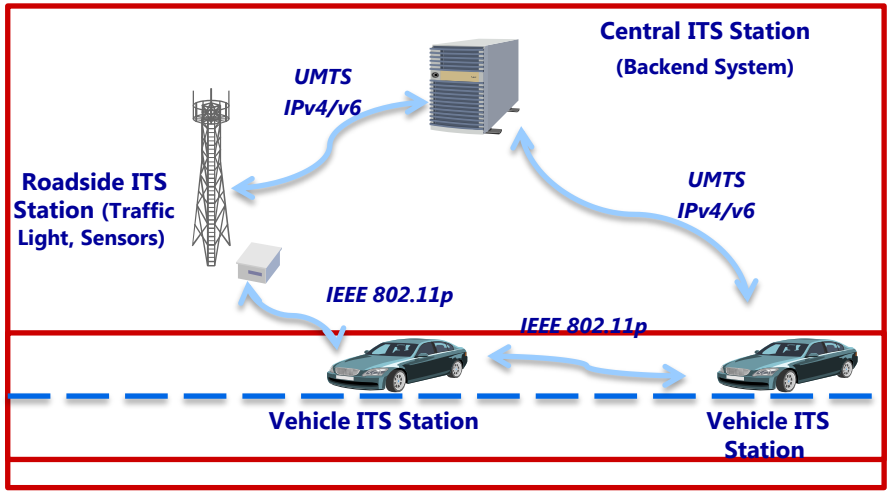
Reference systems developed in DRIVE C2X :

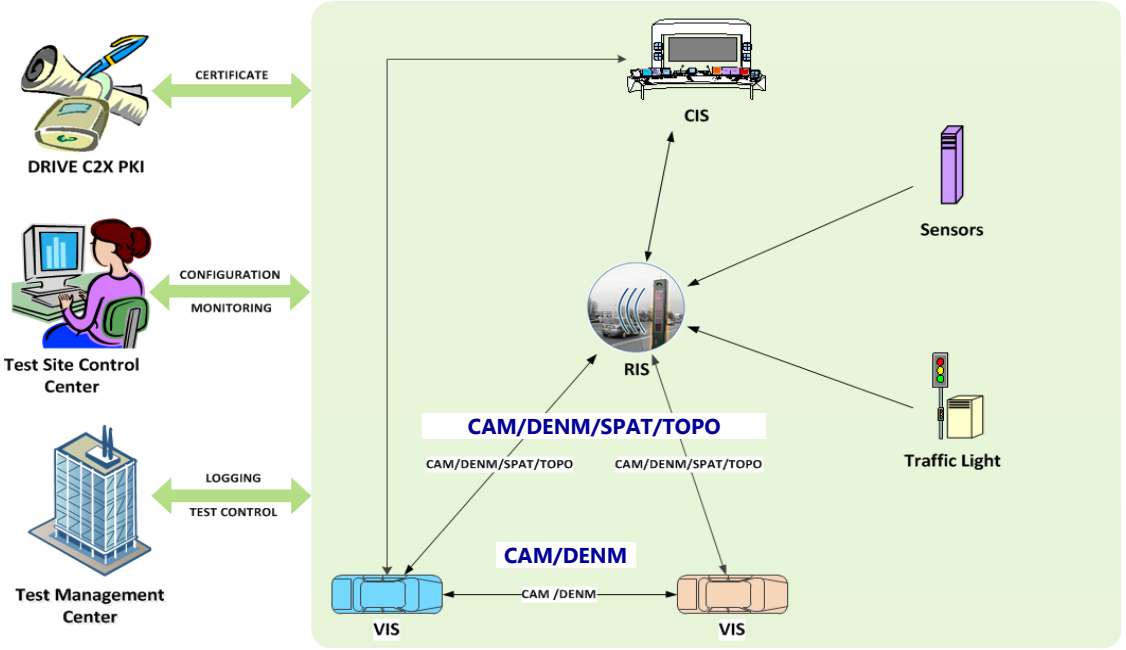
VIS (Vehicle ITS station) integrated with in vehicle network.

RIS (Road ITS station) interfaced with road side sensors and equipment's.

CIS (Center ITS station): including management center, test center, and DRIVE C2X PKI.







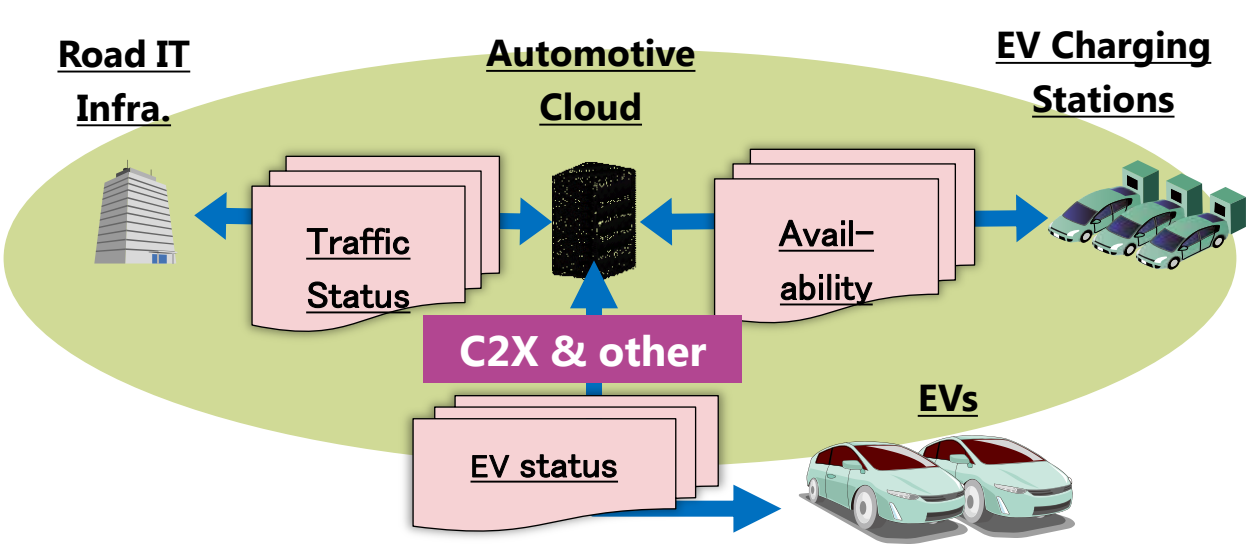
Hitachi is the provider of V2X platform reference system for DRIVE C2X and for SCORE@F. The V2X platform is validated in ETSI plug test.

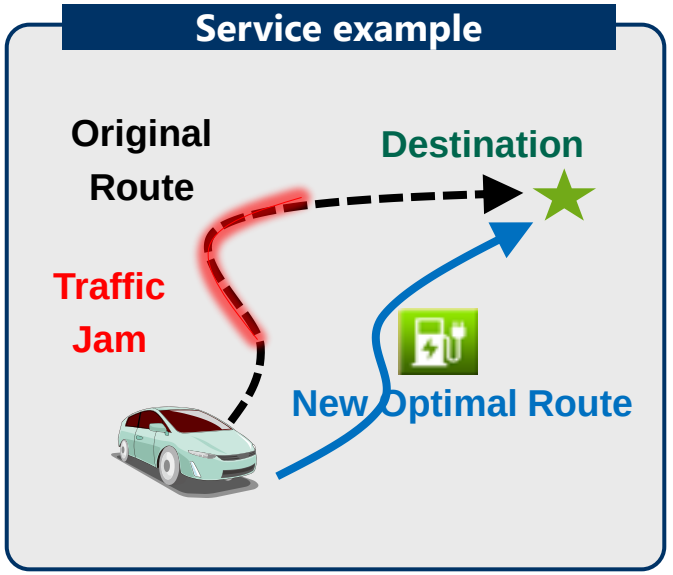
All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Usage of C2X technologies in eCo-FEV*

EU Smart Mobility Project for EV-infrastructure cooperation

Period	September 2012 – May 2015
Partners	Hitachi (ICTL is Coordinator), Renault, Fiat + 10 organizations
Goals	・To develop a standardized platform ・To exploit infrastructures' info for advanced EV cloud services





* eCo-FEV: Efficient Cooperative Infrastructure for Fully Electric Vehicles

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Aim of eCo-FEV project

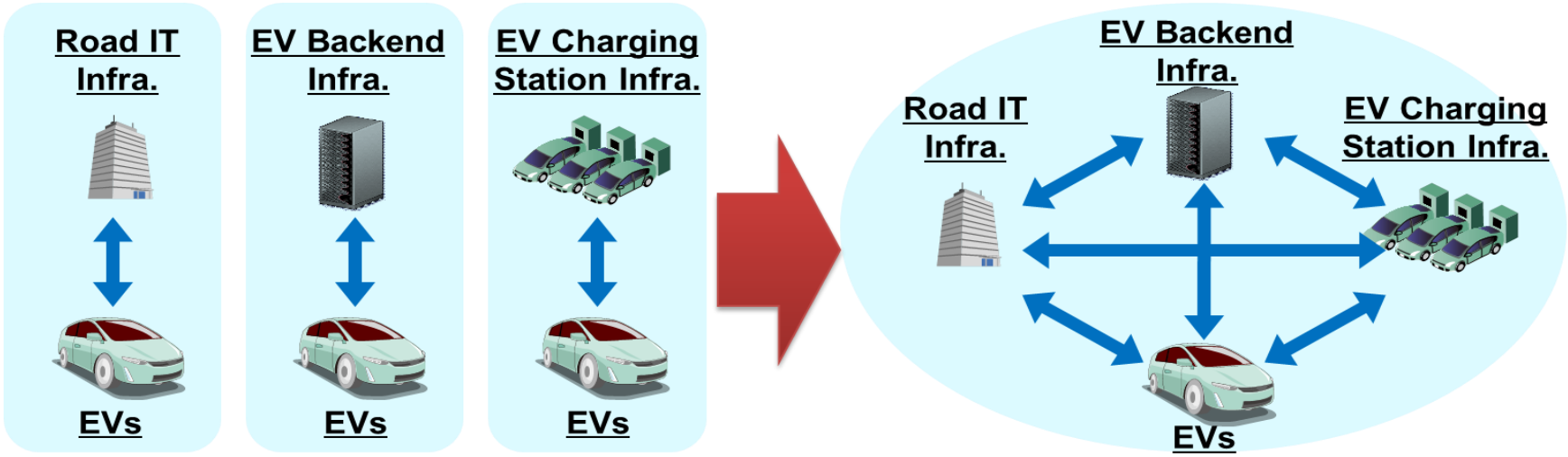
HITACHI
Inspire the Next

Current Issues

- **Smart Mobility City is realized through the coordination of different infras.**
- **But each infrastructure is working separately.**

Project Aim

To define a platform to enable information exchanges between multiple infrastructures for more organic ITS services for EV



EV: Electric Vehicle

All Rights Reserved, Copyright © 2000~2013 Hitachi Europe Ltd.

Thank you

HITACHI
Inspire the Next

Lan.lin@hitachi-eu.com